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EDITORIAL

Patient blood management is a win-win: a wake-up call

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Preoperative anaemia is frequent in surgical patients and increases postoperative mortality, major morbidity, and length of hospital stay.[1] Poorly controlled bleeding and surgical blood loss can also contribute to these outcomes. Anaemia, blood loss, and liberal transfusion triggers are the main predictors for red blood cell (RBC) transfusion.[2] RBC transfusion in turn is an additional independent predictor for adverse outcome and has therefore been referred to as the 'second hit' for the recipient.[3] Transfusion outcomes include higher mortality, more ischaemic complications, organ dysfunction, infections, delayed wound healing, and increased length of hospital stay.[4–8] Transfused patients may also be more likely to develop non-Hodgkin lymphoma.[9] Interestingly, most of these complications are found after administration of just a single RBC unit.[10 11] Strict application of the Bradford-Hill criteria strongly suggests that the link between transfusion and adverse outcomes is causal and not just associative.[6 12]

A further challenge is the surveillance for newly emerging and re-emerging pathogens. Protozoan parasites in the blood donor pool cause babesiosis and Chagas disease, and transfusion-transmitted viral infections such as dengue and chikungunya represent real threats to public health systems.[13] Recently, a transgenic mouse model demonstrated how human tau protein from injected Alzheimer's disease brain extracts, spreads, and co-aggregates with endogenous mouse tau.[14] These findings suggest that tau pathology may develop in the brain by a prion-like mechanism.[15] Similar to the pathogenesis of variant Creutzfeldt–Jakob disease (vCJD), transfusion might play a role in one of the infective pathways.[16]

Transfusion of RBCs,[8] the treatment of adverse transfusion outcomes,[17] and expanding surveillance systems result in considerable financial burdens for all health systems in the developed world.

Patient blood management (PBM) has recently been described as a concept pre-empting and significantly reducing the resort to transfusions by addressing anaemia, blood loss, and hypoxia as modifiable risk factors that may result in transfusion long before transfusion may even be considered. The three pillars of PBM—detection and treatment of preoperative anaemia, reduction in perioperative blood loss, and harnessing and optimizing the patient-specific physiological reserve of anaemia (including restrictive haemoglobin transfusion triggers)[18] (Table 1)—have been proposed for years as a new standard of care to avoid the above described complications and costs.[18] PBM was also adopted by the World Health Organization (WHA63.12) in 2010 as a principle to improve transfusion safety. Since then, the WHO has been urging member states 'to promote the availability of transfusion alternatives including, where appropriate, autologous transfusion and patient blood management'.

In Europe, however, few PBM programmes have been started so far. Kotzé and colleagues thus have to be congratulated for their study in the *British Journal of Anaesthesia* describing the implementation of such a programme in a Yorkshire hospital.[19] Their programme was developed in three stages: first, they analysed the anaemia prevalence and transfusion rates in their centre and explored the local associations between preoperative haemoglobin, RBC

Table 1 Patient blood management. ESA, erythropoietin-stimulating agent

Detect and correct preoperative anaemia and iron deficiency
Iron (i.v.)+ESA perioperatively
Reduce perioperative RBC loss
Meticulous surgical technique
Acute normovolaemic haemodilution
Cell salvage and re-transfusion
Avoidance of coagulopathy with an individualized, goal-directed coagulation algorithm and the use of anti-fibrinolytics and factor concentrates
Low CVP, no hypertension, normothermia
Harness and optimize physiological reserve of anaemia
Tolerate low haemoglobin values
High $F_{I_{O_2}}$
Minimizing metabolic demand

transfusion, and hospital outcomes, including the length of stay and re-admission rate after discharge; secondly, they designed their local treatment algorithm; thirdly, they prospectively collected post-implementation data including costs.

With their PBM programme, they succeeded in significantly reducing the anaemia prevalence from 26% to 10%, perioperative RBC loss by ~20%, transfusion rate for total hip arthroplasty from 23% to 8%, and in total knee arthroplasty from 8% to 0%.[19] In addition, they succeeded in reducing the length of hospital stay from 6 to 5 days in total hip arthroplasty and from 6 to 4 days in total knee arthroplasty, and to reduce the 90 days re-admission rate from 14% to 8%. These are indeed impressive results.

Drug costs were low (£16 695) and largely offset by the costs of avoided RBC transfusion (£12 625). However, as acknowledged by the authors, they used blood bank acquisition costs for RBC for their calculation and not activity-based costs which are three to four times higher.[8] It is important to note that they did not account for 404 fewer days of hospitalization and that ~16 fewer patients were re-admitted within 90 days after operation. Using an estimated average cost of £400 per hospital stay day in the UK and several thousand pounds for re-admissions, the PBM team would have achieved a net saving of over £160 000. Shifting the emphasis from product centred transfusion practice to PBM represents a win-win situation that is extremely rare in medicine: patients get home sooner, hospitals generate cost savings by using fewer resources per patient, and physicians achieve better clinical outcomes.

Optimal PBM includes the detection of anaemia sufficiently in advance of the planned operation which certainly is a logistical challenge. A very promising approach, as used by this group,[19] is to include the general practitioner in the preoperative optimization of the patient and to use a simple algorithm, based on haemoglobin and ferritin measurements (http://www.nba.gov.au/guidelines/module2/index.html#guidelines/module2/po-v2a.pdf, accessed 11 March 2011),[19 20] to treat anaemia. In orthopaedic surgery, anaemia treatment usually starts 4–8 weeks before the operation; in cardiac surgery, this may be more difficult but may not be necessary. Recent studies indicate that a very short-term treatment with erythropoiesis-stimulating agents and i.v. iron starting only 2–0 days before surgery reduces RBC transfusions and improves clinical outcome.[21 22] This may be a useful concept in orthopaedic surgery.[23]

For the reduction in perioperative blood loss, a bundle of measures needs to be combined (Table 1). The most important is a meticulous surgical technique aiming at minimizing blood loss. Discussion with surgical colleagues the disadvantages of insufficient haemostasis and the advantages of minimizing blood loss is worthwhile. Along with acute normovolaemic haemodilution and cell salvage, an individualized, goal-directed coagulation algorithm and the use of anti-fibrinolytics such as tranexamic acid and, probably soon again, aprotinin (http://www.ema.europa.eu/ema/index.jsp?curl=pages%2Fnews_and_events%2Fnews%2F2012%2F02%2Fnews_detail_001447.jsp&mid=WC0b01ac058004d5c1&jsenabled=true, accessed 24 February 2012), and factor concentrates are important.[24–26] Low haemoglobin transfusion triggers are another important element to reduce the transfusion rate. Low haemoglobin transfusion triggers, such as <70 g litre^{-1} in general surgical patients[27] and <80 g litre^{-1} in elderly high-risk patients, are well tolerated.[28] In selected patients, treatment to maximize oxygenation and minimize metabolic demand might be required to avoid transfusion.

This is a wake-up call for physicians, hospital administrators, and regulators. The incidence of preoperative anaemia is known to be high (20–40%),[1 4 29] associated with increased mortality and major morbidity,[1] and associated with transfusion of RBC that again increases mortality, major morbidity, and hospital length of stay.[4–7 10] However, too few have changed from the transfusion-based culture. Therefore, we all should take this study as a model and implement our own local PBM programme—it is time to wake up!

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